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LEARNING TO GROW? CONNECTING HIGHER EDUCATION AND ECONOMIC DEVELOPMENT

An Undergraduate Research Scholars Thesis

by

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ABSTRACT

Learning to Grow? Connecting Higher Education and Economic Development.
(May 2015)

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Across the United States today, various groups of people are asking similar questions regarding the state of higher education policy. Policy makers at state capitals are questioning the value of higher education in their state, university administrators at campuses across the country are questioning how much it should cost, and families sitting at dinner tables are questioning whether the costs are worth it to them. As higher education policy has become an increasingly relevant debate in politics and our daily lives, it has become clear that many policy questions are worth investigating further. This research explores an important aspect of the national higher education debate by investigating the connection between higher education and economic development at the U.S. state level. Using panel data from 1992-2006 on all 50 U.S. states, this paper examines whether the conferral of different types of college degrees leads to economic development and growth in U.S. states. The results indicate that associates' degrees have a positive and significant impact on GSP growth. In contrast, bachelors' degrees have no effect on GSP growth and may exhibit diminishing marginal returns for state economies. Lastly, advanced degrees have a negative and significant impact on GSP growth.

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SECTION I

INTRODUCTION

The potential externalities resulting from an educated population have long been a part of the academic literature. Dating back as early as Adam Smith's *Wealth of Nations*, there is mention of the societal benefits resulting from "the acquired and useful abilities of all the inhabitants and members of the society" (Smith, 1999). Smith makes direct mention that these abilities, acquired through education, study, or apprenticeship, contribute to an individual's fortune as well as the fortune of the society to which that individual belongs. Today, the social benefits of a highly education population are supported by modern economic growth theory and have been heralded by politicians for decades. However, the Great Recession and shrinking budgets have forced a national reconsideration of the costs and benefits of a university education for individuals and for society. A review of the empirical literature reveals a lack of consensus regarding the connection between higher education and economic development. In addition, very little research has been done that separates the potential societal benefits associated with different levels of higher education in the United States. Because the higher education policies implemented by politicians and university administrators have the potential to significantly affect individuals, families, and state and national economies, it is imperative that we seek to better understand how higher education impacts society and the individuals in it. Here, the potential aggregate externalities associated with higher education at the state level in the United States are examined. This analysis contributes to the literature by analyzing the potential externalities to higher education by level of degree at the U.S. state level.

The State of Higher Education in the United States

For most of U.S. history, it was conventional wisdom to view higher education as a precursor to economic development. As competition heightens over shrinking government funds, policy makers have begun to question the U.S. tradition of investing in public higher education and whether higher education actually serves a public good in their jurisdictions. In most cases, it is not politically popular to oppose governmental support for education. Nevertheless, policy makers have made the decision to decrease appropriations to institutions of higher education when faced with shrinking budgets. What are the implications of these policies on economic growth and development for U.S. state economies?

The economic difficulties of the past decade have forced a national conversation about the costs and benefits of a university education for individuals and for society. This research explores an important aspect of the national higher education debate by investigating the connection between higher education and economic development at the U.S. state level. More specifically, this paper examines whether the conferral of college degrees leads to economic development and growth in U.S. states. Data on conferred degrees is separated by level of degree to better understand the societal impacts of different types of college degrees. Although a significant amount of research has been conducted on the individual private returns to higher education over the last few decades, much less work has been done on the aggregate public benefits. Generally, a consensus exists that obtaining a college degree will confer large and positive gains for an individual. In contrast, the public benefits conferred to society from higher education are less well known. This analysis aims to better understand the public benefits of higher education so that both policy

makers, researchers, and the general public can better conceptualize the total costs and benefits of higher education.

In 2012, 20.6 million students were enrolled at degree granting institutions in the United States, indicating a 35 percent increase in enrollment since 2000 and a 2 percent decrease since 2010.[1] More than 70 percent of these students attend public institutions, and the vast majority of students are enrolled in undergraduate programs (National Center for Education Statistics, 2013).

Along with increasing enrollments, educational attainment rates have increased across the United States. Of 25- to 29-year olds, 34 percent held at least a bachelor's degree in 2013 compared to 29 percent in 2000 (National Center for Education Statistics, 2013). The total stock of college graduates is increasing accordingly with the increase in the flow of college graduates; For the entire U.S. population 25 years and older, 32 percent held at least a bachelor's degree in 2013 compared to 24 percent in 2000 (U.S. Census Bureau, 2003).

However, as university enrollments have increased, state funding has decreased. Not only has the share of funding per student declined, the total share of funding has decreased. In 2012, public institutions received an average of $6,646 per full-time equivalent student in state funding, 27 percent less than the $9,111 (in 2012 dollars) they received five years earlier. Although full-time equivalent enrollment in public institutions increased by 11% over this time, total state funding decreased by 19 percent from $88.7 billion (in 2012 dollars) in 2007 to $72.0 billion in 2012. In other words, not only has the budget pie been divided among more students, the total size of the pie has shrunk as well.

[1] Percentages have been rounded to the nearest percent

It is clear that how we finance public higher education in the United States is changing. While state appropriations made up nearly half of total revenues for public degree granting institutions in 1980, state appropriations make up less than a quarter of total revenues at public degree granting institutions today (National Center for Education Statistics, 2013). If current trends continue, some states would cease all higher education appropriations within a decade (Mortenson, 2012). Notably, Colorado has reduced its state appropriations for higher education by nearly 70 percent since 1980. If this trend were to continue, the state of Colorado would cease all state public expenditures on higher education by 2019 (Mortenson, 2012).

In order to make up for decreases in governmental funding, universities have looked to other sources to maintain their revenues. Namely, universities have begun raising tuition. At public and private universities, the share of tuition and fees of total revenues at degree granting institutions has steadily increased over the last few decades. While tuition and fees made up 13 percent of total revenues at public degree granting institutions in 1980, tuition and fees now make up nearly 20 percent of total revenues at public degree granting institutions. The financing of higher education is increasingly shifting from public to individual financing. By definition, these trends reflect a privatization of public higher education (National Center for Education Statistics, 2013).

Data from the College Board indicate shocking increases in the published tuition and fees at both private and public institutions. Over the 30 years from 1983 to 2013, inflation adjusted average published tuition and fees at public four-year institutions increased by 231% from $2,684 (in

2013 dollars) to $8,893. At public two-year colleges, inflation adjusted published tuition and fees increased by 164% from $1,235 (in 2013 dollars) to $3,264. In comparison, private non-profit 4-year institutions saw inflation adjusted published tuition and fees rise by 153% from $11,909 (in 2013 dollars) to $30,094 (College Board, 2013).

More recent trends indicate that tuition and fees rose 27 percent at public four-year institutions and 14 percent at private non-profit four-year institutions during the five year period from 2008-2013. Although every year since 2008 has seen increases in published prices, the rate of change in prices from 2012-2013 was one percent at public four-year institutions and two percent at private non-profit four-year institutions (College Board, 2013). The small change in prices from 2012 to 2013 is a positive indicator in comparison to the large yearly increases over the past decade.

With large increases in tuition and fees over the last 30 years, it is not difficult to understand the national outcry from students and families regarding the increasing costs of attending college. However, these figures do not tell the whole story as they do not take into consideration the subsequent increases in federal financial aid. When taking financial aid into consideration over the last decade from 2003-2013, net tuition and fees have increased a more moderate amount at public four-year institutions and have actually decreased at public two-year and private four-year institutions over this time. However, when room and board are included with tuition and fees, the increase in net cost of attending either a public or private institution has outpaced the rate of increases in financial aid. Including financial aid, the annual net cost of attending college including room and board in 2013 was $12,620 for public four-year institutions, $5,920 for

public two-year colleges, and $23,290 for private four-year institutions (College Board, 2013). The most important point regarding higher education financing is that, in general, financial aid has not kept pace with the increases in tuition, fees, and room and board. This trend has shifted the costs of higher education from the public to the individual, resulting in the de facto privatization of higher education.

It is important to note that these trends and figures represent averages across the United States. Individual U.S. states differ in their public allocations to higher education, the average net costs of attending a university, and the prevalence of public versus private and two-year versus four-year institutions. For example, in 2013 in-state tuition and fees were highest in New Hampshire, where published tuition and fees for public four-year institutions averaged $14,665. In comparison, the lowest published in-state tuition and fees were lowest in Wyoming, where published tuition and fees for public four-year institutions averaged $4,404 (College Board, 2013). This variation across states is important to keep in mind when interpreting these trends as taking averages unavoidably results in a reduction of information for the sake of summarizing the data.

The privatization of higher education is the current trend in the United States and across many countries globally. However, compared to the educational systems around the world, the United States educational system has traditionally been more public in nature (Black & Sokoloff, 2006; Lambert, 2014). Starting in the early 19th century, two distinctive characteristics of the United States educational system have been its accessibility and decentralization. During this time the United States was unmatched in the breadth of access and public provision of basic education,

leading to the United States comparative advantage in educated and skilled workers (Black & Sokoloff, 2006). Although the first universities in the United States were private, states gradually exerted more control over these institutions. Most states even began their own state universities, with the specific provision for a state university found in the constitutions of almost every state that joined the Union in the early 19th century. It is clear that the leaders in government and the general public understood the importance of all levels of education on the development of society, democracy, and technological progress (Black & Sokoloff, 2006). Today, the rising costs of tuition and decreasing state allocations exemplify that the United States is reversing its historical emphasis on accessibility of higher education.

Effects of Privatization

The two biggest concerns regarding the privatization of public higher education are market failure and equity of access to higher education. Market failure, a situation where a private market is unable to allocate resources in the most efficient way, is of particular concern in the higher education market (Lambert, 2014; Tresch, 2008). In this instance, efficiency can be conceptualized in the standard economic interpretation of Pareto optimality, where an individual cannot be made better off without making someone else worse off (Tresch, 2008). Due to imperfect information on the costs and benefits of higher education, credit market imperfections, and potential positive externalities resulting from higher education, private education markets may not lead to a socially optimal level of investment in higher education. The risk for market failure increases as privatization of higher education continues (McMahon, 2009).

In order for a market to produce efficient outcomes there must be perfect information in the economy. In the higher education market, high school students and their families may not be fully aware of the significant private gains from obtaining a degree. Although the private benefits may be generally accepted in the academic literature (Ashenfelter & Krueger, 1994; Card, 1993; Oreopoulos, 2006a; Oreopoulos, 2006b), high school students and their families may greatly underestimate or be unware of these benefits, especially as increases in tuition present greater upfront costs for students and families (Lambert, 2014; McMahon, 2009).

The second aspect that may lead to market failure in a private higher education market is the presence of credit market imperfections which may disable certain groups of people from accessing credit that is needed to pay for college. Private banks may be unwilling to lend to students and families because of a lack of collateral and uncertainty about the earnings capacity of a student. As there is no guarantee that a student attending a university will obtain a diploma and secure a high paying job, banks may not lend to students who need financial assistance to fund their education (Lambert, 2014; McMahon, 2009).

The third reason why a private market for higher education may be inefficient is the possibility of positive externalities. If positive externalities exist, then individuals will choose to invest less than the socially optimal amount in a private market. As this is the subject of this paper, if higher education is found to have positive externalities on economic growth and development, this would be an indication that governmental intervention is needed to produce the socially optimal amount of higher education (Lambert, 2014; Tresch, 2008).

Additionally, even if a privately funded higher education market ran efficiently, there might still be concerns regarding equitable access to higher education. If a government were concerned about the opportunities for social and economic mobility for individuals in a society, then they might choose intervene in the higher education market (McMahon, 2009).

It is important to note the arguments against government provision of education, most of which cite efficiency concerns resulting from a monopoly of the provision of education. These arguments are less applicable to higher education than primary education in the United States as public institutions of higher education are relatively decentralized and compete with other public and private institutions on a greater scale than primary schools do (McMahon, 2009). Unlike in the primary education market, students generally have much more school choice in the higher education market, leading to competition within the public and private aspects of the market.

The presence of a market failure due to imperfect information, credit market imperfections, or positive externalities is commonly cited as justification for governmental intervention in higher education markets. Although the higher education system in the United States is not completely privately financed, the trends toward privatization cause concern that we are not producing the socially optimal number of college graduates.

Additionally, as the U.S. economy becomes increasingly knowledge based and reliant on highly skilled labor, the production of college graduates is raising questions for many researchers and governmental agencies (McMahon, 2009). Many researchers and policy makers expect higher education will be critical to U.S. economic competitiveness in the coming years due to changes

toward an increasingly knowledge based economy. Indeed, the Bureau of Labor Statistics project that from 2012-2022, occupations that require postsecondary education will, on average, grow faster than occupations that require a high school diploma or less (Bureau of Labor Statistics, 2013). Even though college enrollments have increased by nearly 40% since 2000, it is likely that demand for college educated workers will continue to rise at a faster rate due to these economic and employment trends (National Center for Education Statistics, 2013).

These trends have caused concern among scholars and researchers as it is not clear that the U.S. supply of highly educated labor will be able to match the increased demand. Many conclude that the United States is at risk of losing its comparative advantage in highly skilled labor and research and development if we are unable to produce enough college graduates to meet demand for skilled labor (McMahon, 2009). As higher education becomes increasingly important in industrialized countries, it is important to understand the market complications and potential externalities of higher education so that we can incentivize a socially optimal amount of higher education.

Theories Connecting Higher Education and Economic Growth

Endogenous growth theory and human capital theory provide a foundational theoretical connection between higher education and economic growth. Although no model of economic growth is universally accepted, endogenous growth models are the dominant school of thought in modern economic growth literature. A further analysis of endogenous growth models provides a theoretical foundation connecting higher education to economic growth. The endogenous growth models first modeled by Lucas and his student, Romer, give a significant emphasis to the central

role of human capital and education in economic growth theory (Lucas, 1988; Mankiw, Romer, & Weil, 1992; Romer, 1990). In comparison to the growth models that previously dominated growth literature, adherents to endogenous growth models find that investments in human capital are at least as important as investments in physical capital to the growth and success of an economy (Mankiw, 2009).

Lucas' model of endogenous growth indicates that the average level of education in a society plays an important role in the development process (Lucas, 1988). While Lucas' emphasis on the average level of education has implications for education in general in developed and developing countries, work by Romer implies that higher education will be enormously important for the growth of developed countries as institutions of higher education are centers for research and development in developed countries. Specifically, Romer's work suggests that higher education will play a key role in economic growth through the creation of knowledge and technology, the training of researchers, and the dissemination of knowledge that takes place at institutions of higher education. Since the economic returns on research and ideas cannot be completely patented or captured by the researcher, the benefits of this new knowledge spillover into society and lead to growth for society as a whole (Romer, 1986). While less developed countries may benefit more from investing in basic education in order to increase the average level of educational attainment in an economy, developed countries may benefit more from focusing on higher education as technological progress leading to spillovers into society is more likely if human capital is expanded at higher levels of education (Krueger & Lindahl, 2001). In conclusion, endogenous growth models indicate that economic growth will result from

increasing the level of education of a society because investing in education will lead technological growth and spillovers into society resulting from new knowledge.

In addition to endogenous growth theory, human capital theory provides a theoretical basis to examine the impact of higher education on economic growth. Beginning in the 1960's and 1970's, Theodore Shultz and Gary Becker were among the first to bring significant attention to the importance of human capital and education in understanding economic growth and the productivity of labor. Schultz's seminal paper on investment in human capital claimed that human capital and education explained the increases in the productivity of labor in developed countries and helped explain the residual observed between increases in national output and increases in physical capital and labor in traditional growth models (Becker, 1964; McMahon, 2009; Shultz, 1961).

At the very heart of human capital theory is the assumption that a more educated society will be a more productive society. Investments in higher education promote economic development by creating a workforce that is more productive and is also better able to create and absorb new technologies (McMahon, 2009; Shultz, 1961). Not only will individuals who accumulate human capital privately benefit from their increased productivities and increased wages, there are spillover effects into the rest of society. Work by Lange and Topel (2006) concludes that schooling directly increases productivity. Moreover, individuals with greater human capital, as measured by the average years of schooling, raise the productivities of others with whom they interact (Lange & Topel, 2006). This research indicates that there could be vast economic spillovers from investing in human capital.

Working within the framework of endogenous growth and human capital theories, there are numerous avenues through which higher education affects economic growth and development. Investments in higher education have been shown to impact numerous social outcomes that provide the basis for a functioning economy (McMahon, 2009). In addition to increasing the productivities of all members of a society and the spillover effects of research and technology, investment in higher education leads to economic growth through higher tax revenues and lower reliance on government support from college graduates (Brady, Hout, Stiles, Gleeson, & Hui, 2005; Trostel, 2010). Not only does the average college graduate pay more in taxes than the average non-college graduate, they also receive far less governmental assistance than non-college graduates in regards to welfare assistance, unemployment benefits, and other social assistance programs. The average real fiscal internal rate of return on governmental investment in higher education is conservatively estimated to be 10.3% (Trostel, 2010).

Higher education has been found to impact several other social factors that may indirectly effect economic growth and development. In developed countries, higher education significantly increases civic engagement, voter participation, democracy, and political stability (Dee, 2004; Keller, 2006; McMahon, 2007; McMahon, 2009; Milligan, Moretti, & Oreopoulos, 2004). Higher education's role in improving these governmental factors is a slow but potentially vital process for the growth of countries and economies (McMahon, 2007). Additionally, education has been linked to lower crime rates in the United States (Lochner & Moretti, 2004). However, most of the empirical work investigating the connection between education and crime focuses on secondary education rather than higher education. Furthermore, increased access to higher

education tends to decrease inequality in the United States (Leslie, 1988; McMahon, 2007). In an analysis of states in the U.S. Deep South, McMahon (2007) finds that reducing inequality in the U.S. Deep South requires improving high school drop outs rates, improved basic education in low-income areas, and greater use of need-based college financial aid. As the distribution of incomes is an important aspect of a state economy, we might be particularly interested in the effects of higher education policy on measures of inequality.

It is important to understand that the impact of higher education on economic growth is a dynamic process; The effects feedback and accumulate over generations. Investments in higher education establish a foundation for growth and development that builds upon the previous generation. The productivity, income, and education of today's workforce were all significantly impacted by the ability of the last generation to accumulate knowledge and technology (McMahon, 2009). Given this, the externalities of education must be viewed as a cumulative, dynamic process. In other words, the accumulation of human capital is not merely a phase in development but a continual process of maintenance and renewal. This indicates that the effects of investing in higher education will grow over time and that studies that take a short term view of economic growth may not capture the true long run social benefits of higher education.

Literature Review

While the economic benefits of an educated population are supported by endogenous growth and human capital theory, a review of the literature reveals little research has been done on *how* to prioritize education policy. Of the research that attempts to account for the aggregate impacts of higher education on economic development, the majority focuses broadly on educational

attainment averages or years of schooling in general. Moreover, only a few studies have been done on individual U.S. states. The bulk of the literature focuses on the global trends and utilizes cross-national data to determine the aggregate impact of higher education on economies. Along with this research, these studies test the theoretical basis in endogenous growth models and human capital theories that higher education leads to economic growth.

Among the studies using cross-national data, Bils and Klenow (2000) and Pritchett (2006) find insignificant impacts of education on economic growth. Bils and Klenow (2000) examine the impact of enrollment rates on economic growth rates, and find that the impact of enrollment rates on economic growth explains less than one-third of the observed relationship between economic growth rates and enrollment rates across countries. In their analysis, Bils and Klenow (2000) posit that increases in labor supply or omitted variables may account for the strong correlation observed between schooling enrollments and income growth. They conclude that a reverse causality may drive the relationship such that higher economic growth rates may cause higher enrollment rates, and not the other way around. Pritchett (2006) examines the past literature and extends it with a cross-national study, concluding that the empirical data does not indicate any output externalities for education.

Of the studies using cross-national data, Krueger & Lindahl (2001) and Keller (2006) find positive impacts of education on growth. Keller (2006) analyzes the effects of primary, secondary, and higher education in developed and less developed countries. Keller utilized data from 1960-2000 for flow measures of education: enrollment rates, public expenditures, and educational expenditures per student. The results varied significantly between developed and less

developed countries. Keller concludes that less developed countries should prioritize lower levels of education while developed countries should focus on emphasizing secondary schooling and college enrollment rates in order to enhance economic growth. In another study, Krueger & Lindahl (2001) find that average years of schooling is statistically significant and positively associated with economic growth for countries with the lowest levels of education. However, they conclude that cross-country regressions would indicate changes in education had more significant impacts on economic growth if measurement error in education was accounted for.

Much less empirical research has focused on individual country level data. Of this smaller branch of literature, Aghion et al. (2005) find interesting results by comparing the returns to higher education across the United States. Aghion et al. (2005) examine the relationship between economic growth and higher education with respect to how far each U.S. state is from the technological frontier. Specifically, the authors examine the economic effects of investing in different levels of higher education in the U.S. in reference to whether the US state is close to or farther from the technological frontier, as measured by gross state product. Moreover, Aghion et al. (2005) posit that internal migration will exaggerate the differences seen in returns on education between states that are at the opposite ends of the technological frontier. Aghion et al. (2005) conclude that investing in high-brow education (4-year and advanced degrees) has a greater payoff for states that are closer to the technological frontier. Further, they conclude that investment in low-brow education (2-year degrees) has a greater payoff for states that are farther from the technological frontier. The findings in Aghion et al. (2005) indicate that education's impact of growth will vary significantly depending on the region and state in question.

SECTION II

DATA AND METHODS

Data

Measuring the development and wellbeing of state economies is often complex due to the multifaceted nature of economies. In this analysis, various indicators of economic development are utilized to capture various components of a state economy. Moreover, a multitude of state, national, and political factors are thought to impact the overall health of a state economy. Many control variables are utilized to account for omitted variable bias and so that the individual effects of the higher education variables can be separately estimated. Data for variables in this analysis are available for the years 1992-2006, allowing for 15 years of observations for all 50 U.S. states.[2]

The main independent variables in this analysis are higher education outputs measured as conferred degrees in a state per year. The higher education variables for degrees conferred were collected from the Integrated Postsecondary Education Data System (IPEDS) specifically for this analysis. Conferred degrees are included for each state per year and include degrees conferred from degree granting, Title IV institutions. Degree variables are separated by associates', bachelors', or advanced degrees in order to distinguish the impact of the level of degrees on economic development. Advanced degrees include masters, doctorate, and professional degrees. All degree variables are weighted by per thousand population in a state per year.

[2] Data for the net change in job creation rate is available until 2005

State economy and control variables were sourced from the *Economies of States Data Set* provided by Soledad Artiz Prillaman (Prillaman, 2013)[3]. Economic growth and economic development can be operationalized in various ways due to the multifaceted nature of economies. Because of the various components of a state economy, different dependent variables are used as measures of the health of a state economy. The real growth rate of gross state product (GSP), change in poverty rate, change in employment rate, the real growth rate in per capita personal income, and the change in net job creation rate are used as measures of the development of a state economy. The utilization of many dependent variables enables us to have a more complete understanding of the effects of higher education and our control variables on a state economy.

State economies are impacted by numerous state, national, and political factors. Numerous control variables are included in order to account for these impacts. A state's log population, percentage of high school graduates, price of land price, price of energy, and union density are included to account for state characteristics that have been known to impact state economies. A state's government ideology and real per capita expenditures on police, corrections, public welfare, health, highway, and K-12 education are included to account for state political characteristics that affect state economies. Moreover, the wellbeing of the national economy significantly impacts the growth of state economies. To account for the health of the national economy, GDP per capita growth rate, the national unemployment rate, and the prime rate that banks charge their most credit worthy customers are included in the analysis.

[3] The author would like to extend her thanks to Soledad Artiz Prillaman for providing this data.

Methods

Economies are systems derived from the interaction of many different variables and factors. To account for concerns of endogeneity in the model, the general method of moments (GMM) Arellano-Bond estimator is used to estimate the impacts of higher education on economic development. The Arellano-Bond estimator uses lagged levels of the dependent variables as instruments to account for endogeneity, and it also corrects for heteroskedasticity and autocorrelation concerns that are prevalent in panel data (Arellano & Bond, 1991). Post regression diagnostics indicate that our model corrects for autocorrelation in the second order but not definitively in the first order. Graphical diagnostics confirm that heteroskedasticity is not a concern in the model, indicating that there is constant error variance.

An assumption for the Arellano-Bond estimator is that this model has more states than years and more years than regressors. Due to data availability, this model has less years than regressors. To account for this, the model was checked for sensitivity by eliminating regressors that were found to be insignificant in the complete regression. When the model was run without 5 control variables (union density, government ideology and police, corrections and health expenditures) the significance of the remaining variables did not change and the coefficients were consistent with the findings in the full model. The results for this check indicated that the results in the Arellano-Bond model were not sensitive to having more regressors than years of data.

Working with panel data presents various econometric complications. If our regressions were run with non-stationary data, our results might lead to spurious or misleading relationships. Because the dependent variables in this analysis are differenced, it is likely that our model does not have a

problem with non-stationary variables. To test for non-stationarity, various unit root tests were conducted. Fisher-type unit root tests with the Phillips-Perron option rejected the null hypothesis of a unit root for all dependent variables at several lags.

SECTION III

RESULTS

The five Arellano-Bond models of state economic development were estimated for years 1992-2006[4]. The results are reported in Table 1. The model for growth of GSP is the most direct measure of a state's income and serves as the focus of this analysis. The theoretical evidence presented in this paper focuses on higher education's impact on productivities and externalities that result in the growth of state income. Because of this, higher education may affect GSP growth more significantly than other aspects of a state economy. However, all five aspects of the economy are important to consider in order to have a complete understanding of the health of a state economy.

Model for Growth of Gross State Product

The results for the GSP growth rate model indicate that associates' degrees have a positive and significant relationship with GSP growth. In contrast, bachelors' degrees have an insignificant relationship with GSP growth. Advanced degrees have a negative and significant relationship with GSP growth. These results suggest that states should invest more in associates' degrees in order to raise GSP. In comparison, these results suggest that states should not invest more in more bachelors' and advanced degrees in order to immediately raise GSP.

More substantively, our results indicate that an increase in one associate's degree per thousand population will result in 1.2919 percentage point increase in GSP growth. Firstly, an increase of

[4] The model for the change in net job creation rate has data from 1992-2005

one degree conferred per thousand population indicates a very substantial increase in degree production. In 2006, the average number of associates' degrees conferred per thousand population was 2.4226, and the standard deviation was 0.8689. For the average state, an increase in one associate's degree per thousand population would indicate a 41 percent increase in the number of associates' degrees per thousand population, a sizable increase that is unlikely to occur over the course of a few years. The results indicate that this large increase in the number of degrees conferred will result in a 1.2919 percent increase in GSP growth, which is very large increase in GSP growth. In comparison, the average GSP growth rate in 2006 was 5.9871. For the average state, this would indicate that an increase of one associate's degree conferred per thousand population would result in nearly a 22 percent increase in GSP growth. These substantive meanings must be taken into consideration when interpreting the results for all five models in order to get a clear sense of the impacts.

How can we interpret the results for bachelors' and advanced degrees? Bachelors' and advanced degrees are significant time investments for likely productive members of society. Because bachelors' and advanced degree recipients are not contributing to GSP for the long time periods that they are attending college, it may not be surprising that we observe negative or insignificant effects from these degrees on GSP growth when the degree variables are not lagged.

It may be the bachelors' and advanced degrees are a long term investment for a society. In an economy, individuals earning associates' degrees may be may have a more immediate impact on GSP growth than bachelors' and advanced degree recipients, who may have a delayed impact on GSP growth. Those obtaining an associate's degree may be able to immediately apply the skills

obtained from their degree in their career and contribute significantly to an economy. In comparison, those obtaining a bachelor's or advanced degree may initially take a job that does not utilize all of the skills these individuals obtained in college, which may result in a delayed impact on state GSP from these individuals. To test whether bachelors' and advanced degrees have a lagged impact on growth, a model for GSP growth rate is estimated using lagged variables for bachelors' and advanced degrees. When bachelors' and advanced degrees are lagged one year, the impact of bachelors' degrees remains insignificant and the effect for advanced degrees remain negative and significant. These results do not change when bachelors' and advanced degrees are lagged two years. It is likely that bachelors' degrees and, particularly, advanced degrees need to be lagged for longer periods of time to get more accurate estimates of their impact on growth. However, due to data availability in this analysis, lagging the data more than two years may cause concerns for the number of observations.

It may be that bachelors' and advanced degrees have diminishing marginal returns, and that states are conferring too many of these degrees for state economies to absorb. To test whether bachelors' and advanced degrees have a non-linear impact on economic growth or exhibit diminishing marginal returns to GSP growth, bachelors' and advanced degree variables were squared and run as a part of the model. Results are reported in Table 2. The results indicate that bachelors' degrees may exhibit diminishing marginal returns to GSP growth, suggesting that states may be producing too many bachelors' degrees for state economies to currently absorb. Secondly, the results indicate that the negative effect of advanced degrees levels off, suggesting that a critical mass of advanced degrees may be necessary for a state to realize positive impacts of investing in advanced degrees.

An important consideration when interpreting these results is that the United States is a very mobile society. Because college graduates often move away from the states where they earned their degree, the analysis of state investment in higher education is often complex. Individuals who earn associates' and bachelors' degrees are significantly more likely to work in the states where they obtain their degree. In comparison, those who earn advanced degrees are significantly more likely to move to another state to work. It may be that individuals earning advanced degrees work in a small cluster of states regardless of where they obtained their degree. This could help explain why we see large negative impacts from advanced degrees on GSP growth. Work by Aghion et al. (2005) and Trostel (2010) begins to examine the impact of inter-state mobility of college graduates on the returns to higher education. Aghion et al. (2005) concludes that individuals earning advanced degrees relocate and work in states that are at the technological frontier as measured by GSP. This indicates that states might prioritize different levels of higher education depending on the technological and economic advancement of their state. Future plans for this research project include accounting for mobility across states by comparing a state's level of educational attainment with the number of college degrees that the state produces. If a state had more college graduates and a higher level of educational attainment than you would expect from its degree production, then you can say that this state is a net importer of college graduates. Using this method, we could then distinguish between states that are importers and exporters of educated labor.

Results from the five models on economic development show that higher education has the strongest connection to the model on GSP growth. The remaining four models are discussed briefly here.

Model for Change in Poverty Rate

We may also be interested in higher education's impact on the distribution of incomes, measured by the change in poverty rate. The results for the change in poverty rate model indicate that neither of the degree variables have an effect on the change in the poverty rate in a state. These results may change if degree variables are lagged for longer periods of time. The only factors that impact the change in poverty are public welfare expenditures per capita, the national GDP per capita growth rate, and the lagged variable for the change in poverty rate. However, it may not be entirely surprising that conferring more degrees does not affect the poverty rate as the type of individuals who obtain degrees are less likely than the general population to be in poverty. Higher education would result in a decrease in the poverty rate if there were externalities for those living under the poverty line or if individuals who obtained degrees would have otherwise been in poverty without a degree.

Model for Change in Employment Rate

The employment rate is an important indicator of economic development for the labor sector in an economy. The results for the change in employment rate model indicate no significant impacts from the degree variables on the change in employment rate. We would expect higher education to have an impact on the employment rate if higher education led to externalities resulting in more employment. Firstly, if higher education led to advancements in technology for

society as a whole, technology could potentially replace human jobs or could create more human jobs with the need to build, maintain, and operate new technologies. Secondly, higher education could result in higher employment rates if college graduates created more jobs and hired more workers. Lastly, higher education could result in higher employment rates if higher education greatly increased your likelihood of being employed. Although those who have college degrees are much more likely to be employed, it is likely that a great majority of the people who obtain college degrees would have been employed otherwise regardless of obtaining a degree. It is interesting to note that the percentage of high school graduates in a state economy has a positive and significant impact on the employment rate. This indicates the post-secondary education has a more significant impact on the state employment rate than higher education.

Model for Per Capita Personal Income Growth

When measuring economic development, we may also be interested in the wellbeing and personal incomes of those already in an economy. The results for the growth rate of per capital personal income model indicate that advanced degrees have a negative and significant impact on the growth rate of per capita personal income. Associates' and bachelors' degrees have insignificant impacts. Similar to GSP growth rate model, we may expect that the impact of the degree variables on personal income would become positive and significant over time if the degree variables were lagged for longer periods of time.

Model for Net Change in Job Creation Rate

The net change in job creation is a similar measure to the change in employment rate as they are both measures of the labor sector of an economy. The results for the change in net job creation

rate model indicate that associates' degrees have a negative and significant impact on the change in net job creation rate. The negative and significant effect of associates' degrees on net job creation seems contrary to economic theory as associates' degrees are theorized to have relatively quick returns for individuals and societies. However, it may be that associate's degree earners are not creating new jobs, just filling existing ones. The results for bachelors' and advanced degrees are insignificant.

SECTION IV

CONCLUSIONS

This research indicates a contribution to the study of the aggregate public benefits of higher education in U.S. states. By utilizing an elaborate set of controls, the estimates represent the individual impacts of the production of college degrees on measures of economic development. Because economies are multifaceted systems, five different measures of state economic development are used to estimate the effects of the production of college degrees. Of the five models estimated, the production of college degrees has the biggest impact on the model for GSP growth rate. The results indicate that associates' degrees are a worthwhile investment for the average U.S. state that is interested in improving GSP growth. In contrast to the economic theory presented in this paper, the results indicate that bachelors' and advanced degrees either have an insignificant or negative impact on state economies. Bachelors' degrees are likely to exhibit diminishing marginal returns for state economies. Moreover, the negative impacts of advanced degrees on GSP growth level off as more advanced degrees are produced in a state. Future research could expand upon this project by adding more years of data, which would enable us to examine the long-run impacts of bachelors' and advanced degrees on state economies[5]. Moreover, an analysis of individual states or regions would enable researchers to explore the effects of labor mobility on the return to higher education for U.S. states.

[5] The author plans to expand this analysis in two ways: (1) include more years of data and (2) include data for field of study to examine the impact of different fields of study on economic growth

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APPENDIX

Table 1 ***Five Models of State Economic Development***

	GSP Growth Rate	**Poverty Rate**	**Employ-ment Rate**	**Growth Rate Per Cap Personal Income**	**Net Job Creation Rate**
Associates' degrees	1.2919*	-0.7987	-0.1931	0.4876	-1.0528*
(per 1000 population)	(0.6559)	(0.5370)	(0.1562)	(0.4068)	(0.4264)
Bachelors' degrees	0.5784	-0.1256	0.0640	0.0975	0.8483
(per 1000 population)	(0.8731)	(0.6834)	(0.1947)	(0.5464)	(0.5472)
Advanced degrees	-4.6405*	1.2382	0.2601	-2.1000*	1.1736
(per 1000 population)	(1.0862)	(0.8344)	(0.2892)	(0.7103)	(0.7897)
State Factors					
Ln(Population)	-12.9490*	3.2323	-1.6984	-20.7665*	-1.3649
	(5.1650)	(3.9144)	(1.1024)	(3.1037)	(3.0961)
% High school graduates	0.0673	-0.0374	0.0368*	0.0127	0.1007*
	(0.0628)	(0.0475)	(0.0142)	(0.0384)	(0.0391)
Price of land	0.0171	-0.0246	0.0288	0.1572*	0.1315
	(0.1287)	(0.0948)	(0.0336)	(0.0783)	(0.0940)
Price of energy	0.4103*	0.0906	0.0674*	0.4578*	0.1162
	(0.1050)	(0.0807)	(0.0283)	(0.0643)	(0.0781)
Union density	0.0676	-0.0098	-0.0126	0.0048	-0.0996
	(0.1342)	(0.0977)	(0.0303)	(0.0836)	(0.0845)
Political Factors					
Government Ideology	0.0027	-0.0043	0.0028	-0.0029	0.0067
	(0.0095)	(0.0064)	(0.0022)	(0.0059)	(0.0061)
Police expenditures	0.0088	0.0005	-0.0085	-0.0277	-0.0010
	(0.0260)	(0.0198)	(0.0060)	(0.0172)	(0.0171)
Corrections expenditures	-0.0017	0.0100	-0.0010	-0.0066	-0.0053
	(0.0088)	(0.0064)	(0.0019)	(0.0055)	(0.0055)
Public welfare expenditures	-0.0002	-0.0028*	-0.0003	-0.0005	-0.0005
	(0.0014)	(0.0010)	(0.0003)	(0.0009)	(0.0009)
Health expenditures	0.0034	-0.0015	-0.0007	-0.0020	0.0007
	(0.0044)	(0.0033)	(0.0011)	(0.0027)	(0.0030)
Highway expenditures	0.0042	-0.0007	-0.0018*	-0.0034	-0.0032
	(0.0028)	(0.0020)	(0.0006)	(0.0018)	(0.0018)
Education expenditures	-0.0011	0.0002	-0.0001	-0.0051*	-0.0003
	(0.0018)	(0.0013)	(0.0004)	(0.0010)	(0.0011)

Table 1 continued

National Factors					
GDP per capita growth rate	0.8515*	-0.2114*	0.0745*	0.1759*	0.4573*
	(0.1128)	(0.0886)	(0.0249)	(0.0759)	(0.0690)
National unemployment rate	-0.2223	0.5385	-0.1098	-1.7297*	0.7564*
	(0.3787)	(0.2938)	(0.0840)	(0.2413)	(0.2313)
Prime rate	-0.1944	-0.1257	0.2472*	0.0030	0.8414
	(0.1664)	(0.1237)	(0.0372)	(0.0960)	(0.1031)
Lagged DV	0.1554*	-0.3176*	-0.1469*	-0.3671*	-0.0432
	(0.0472)	(0.0387)	(0.0432)	(0.0396)	(0.0432)
Constant	191.5337*	-46.0300	22.0017	332.3694	1.2503
	(79.8452)	(60.4926	(16.9353)	(47.8112)	(47.5298)
N	650	650	650	650	600

Note: Standard errors are designated below coefficients and are in parenthesis
*denotes a p-value at a 5% level of significance

Table 2	***Non-Linear Model of GSP Growth***
Associates' degrees	1.5488*
(per 1000 population)	(0.6755)
Bachelors' degrees	4.1729
(per 1000 population)	(2.5244)
Bachelors' degrees^2	-0.3387
(per 1000 population)	(0.2126)
Advanced degrees	-7.3959*
(per 1000 population)	(3.1477)
Advanced degrees^2	0.6098
(per 1000 population)	(0.5513)
State Factors	
Ln(Population)	-14.341*
	(5.2827)
% High school graduates	0.0749
	(0.0630)
Price of land	0.0447
	(0.1326)
Price of energy	0.3689*
	(0.1063)
Union density	0.0460
	(0.1355)
Political Factors	
Government Ideology	0.0038
	(0.0095)
Police expenditures	0.0129
	(0.0263)
Corrections expenditures	-0.0010
	(0.0088)
Public welfare expenditures	-0.0003
	(0.0014)
Health expenditures	0.0026
	(0.0044)
Highway expenditures	0.0047
	(0.0028)
Education expenditures	-0.0006
	(0.0018)
National Factors	
GDP per capita growth rate	0.8402*
	(0.1133)
National unemployment rate	-0.2227
	(0.3809)

Table 2 continued	
Prime rate	-0.1700
	(0.1675)
Lagged DV	0.1582*
	(0.0475)
Constant	205.0092*
	(80.4989)
N	650.0000

Note: Standard errors are designated below coefficients and are in parenthesis
*denotes a p-value at a 5% level of significance